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Gauthier

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(54) **ANIMATION EDITING APPARATUS**

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(51) **Int. Cl.**
G06T 15/70 (2006.01)

(52) **U.S. Cl.** **345/473**

(58) **Field of Classification Search** 345/473–475, 345/419

See application file for complete search history.

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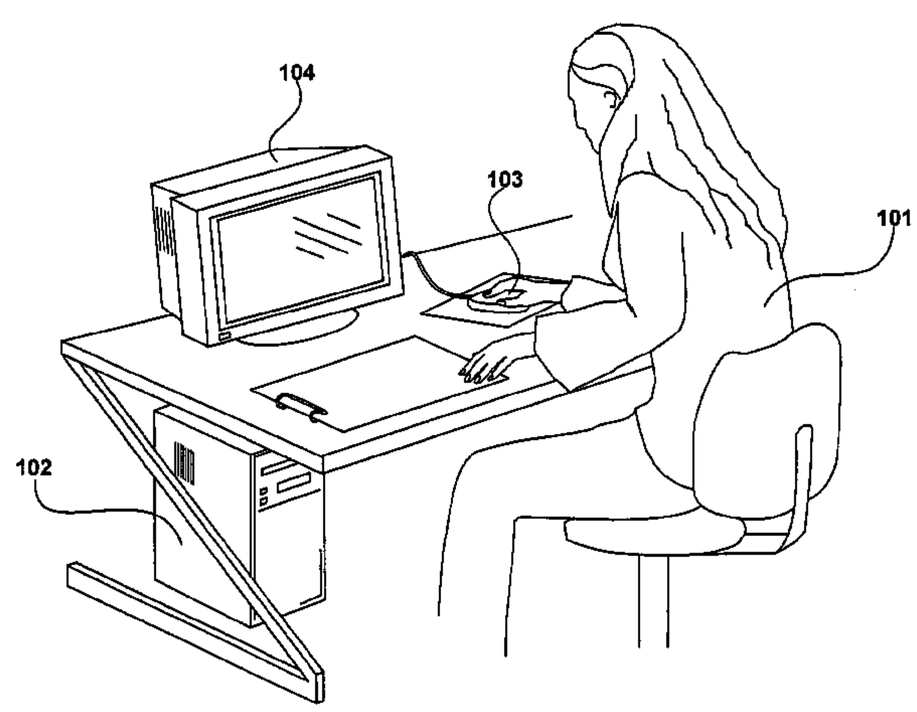
(74) *Attorney, Agent, or Firm*—Staas & Halsey LLP

(57) **ABSTRACT**

Animation editing apparatus for editing animation data, comprising data storage means, processing means, visual display means and a manually responsive input device configured to allow a user to indicate a selected point on the visual display means.

The visual display means displays an image representing a simulated three-dimensional world-space including a plurality of simulated objects, and the manually responsive input device provides an input signal indicating a location within the image corresponding to one of the simulated objects. In response to receiving the input signal, the processing means identifies the selected simulated object, and retrieves data from the data storage means of one or more related items related to the selected simulated object within a defined degree of relationship. The visual display means displays labels identifying the selected simulated object and the related items only.

22 Claims, 18 Drawing Sheets



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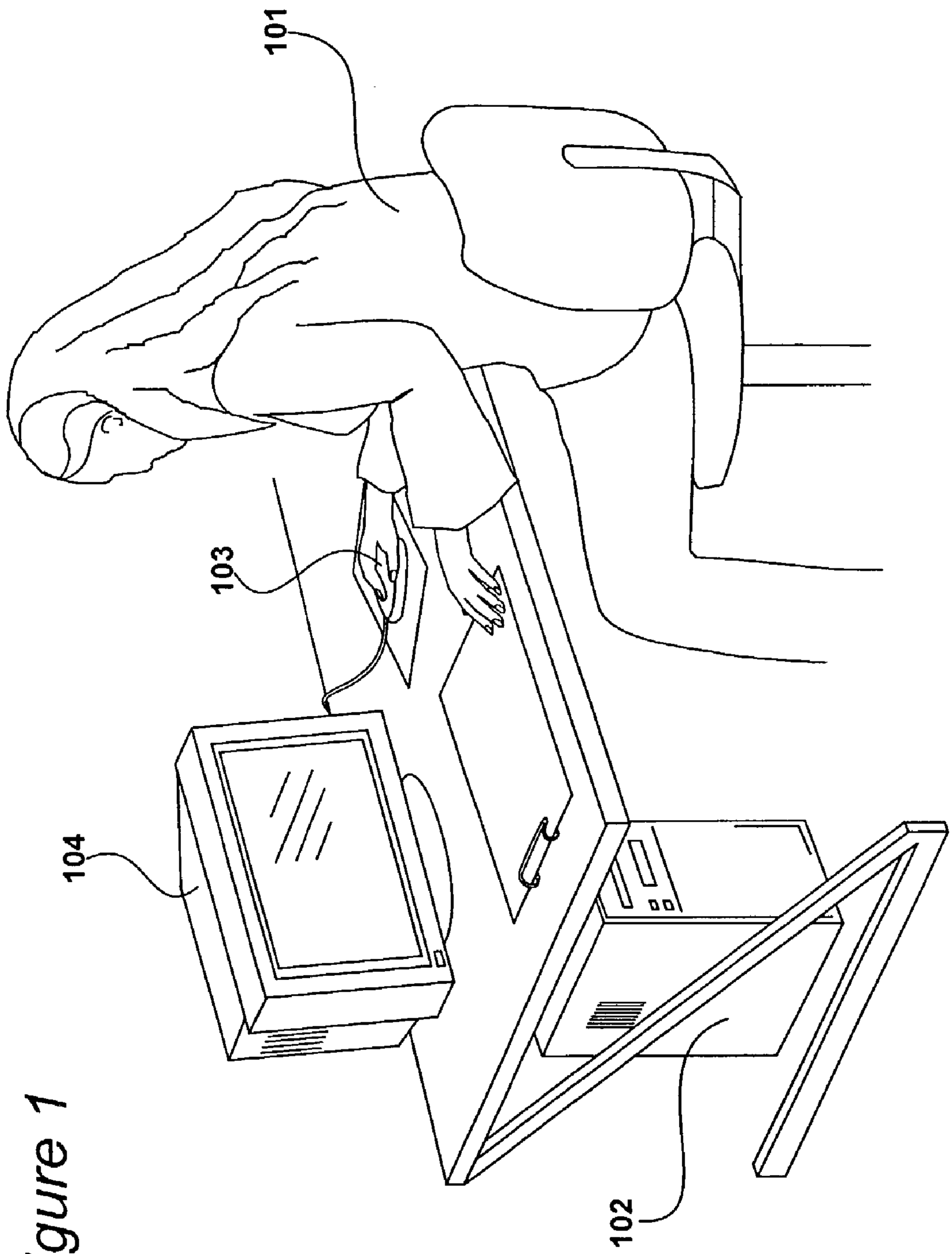


Figure 1

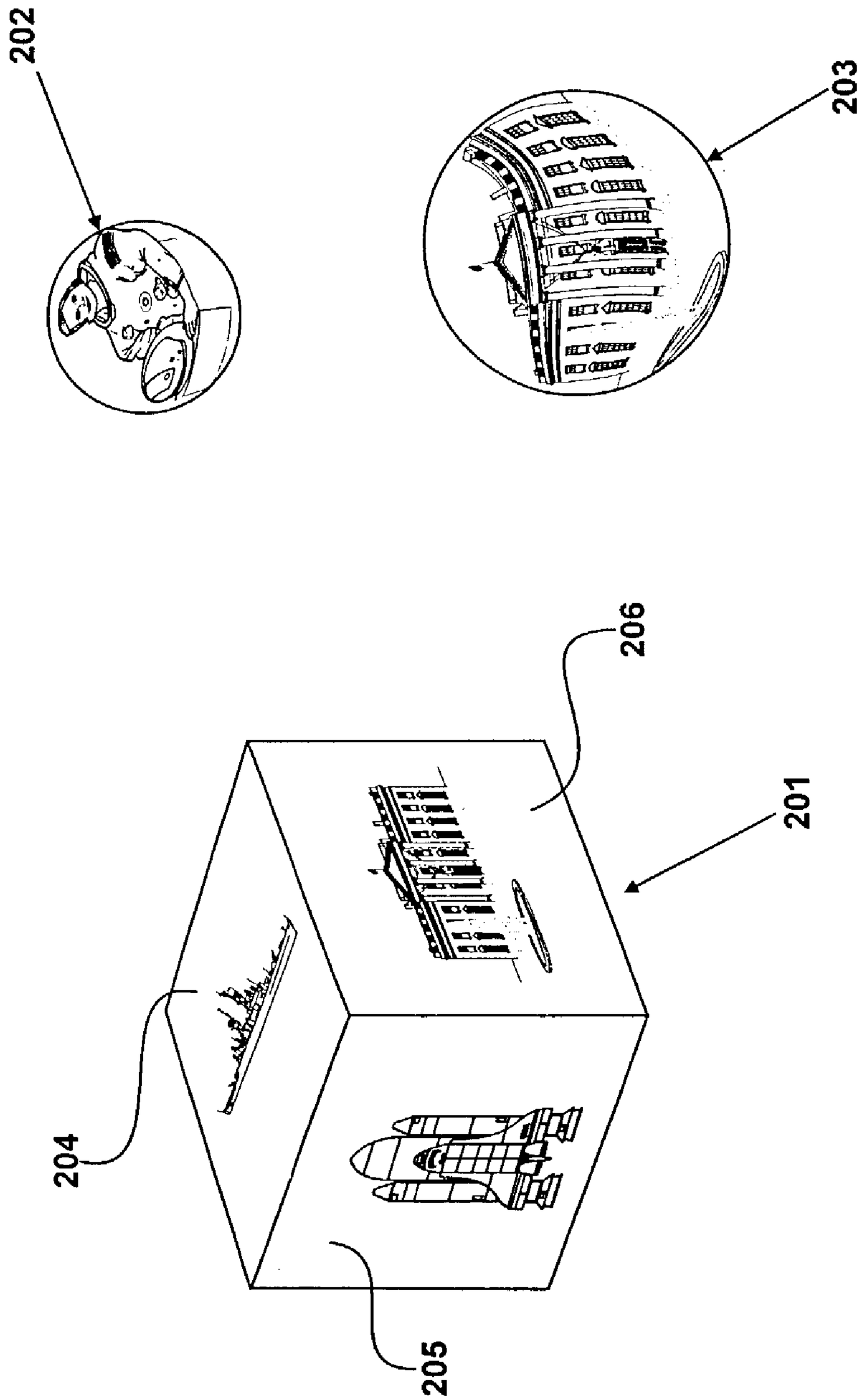


Figure 2

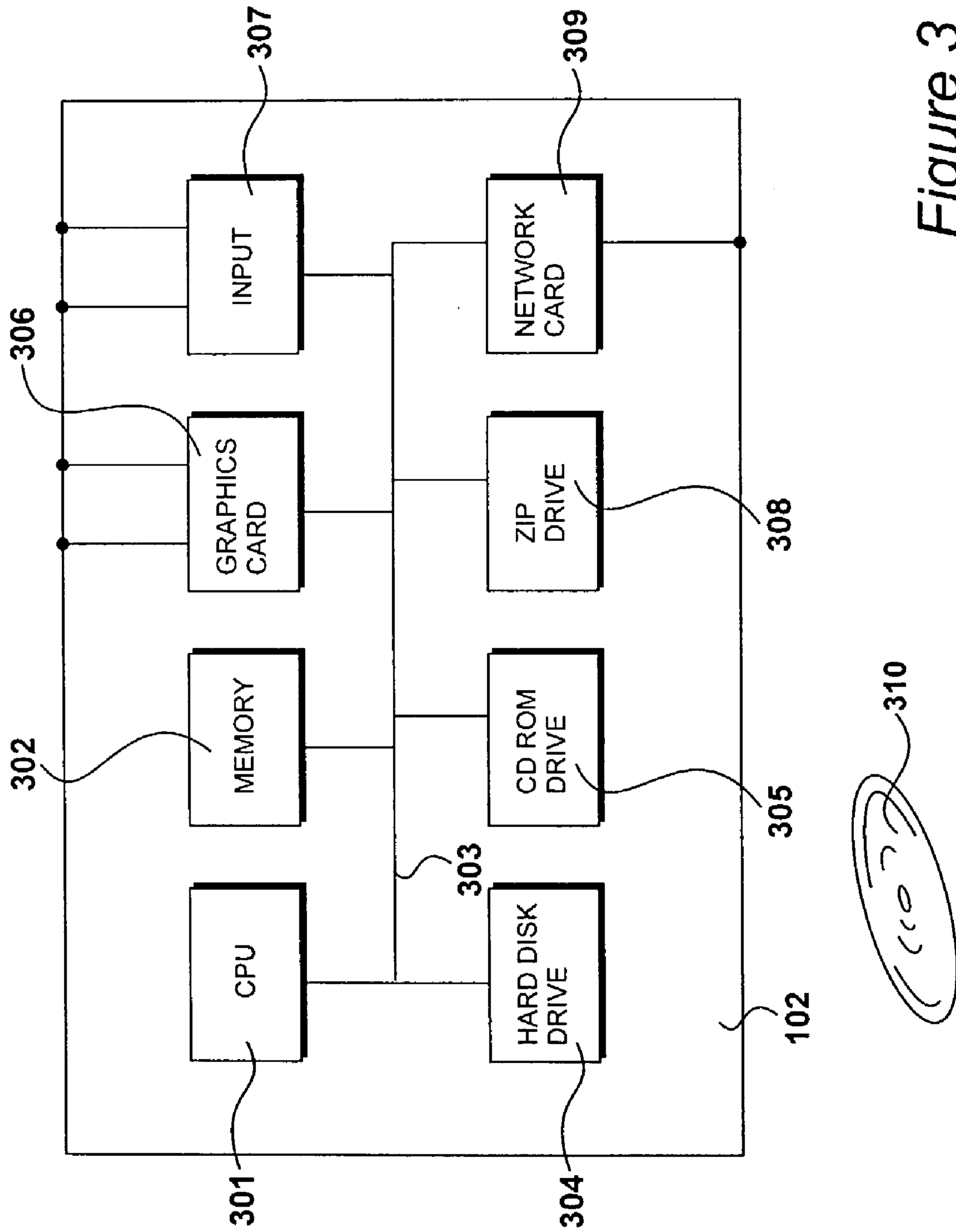

307
309
INPUT
NETWORK CARD
306
GRAPHICS CARD
ZIP DRIVE
308
302
MEMORY
CD ROM DRIVE
310
305
303
CPU
HARD DISK DRIVE
102
301
304

Figure 3

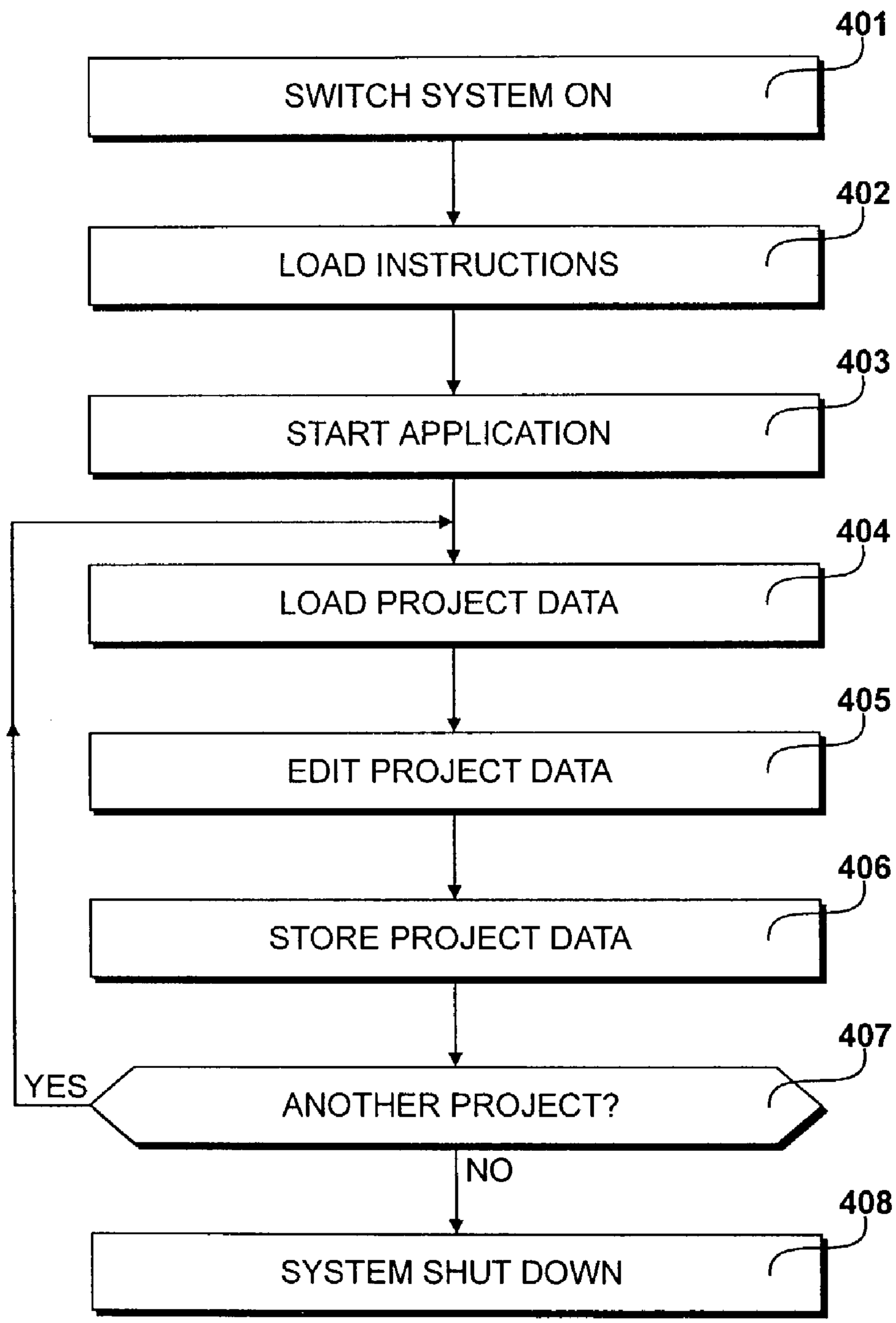

401
SWITCH SYSTEM ON
402
LOAD INSTRUCTIONS
403
START APPLICATION
404
LOAD PROJECT DATA
405
EDIT PROJECT DATA
406
STORE PROJECT DATA
407
YES
ANOTHER PROJECT?
NO
408
SYSTEM SHUT DOWN

Figure 4

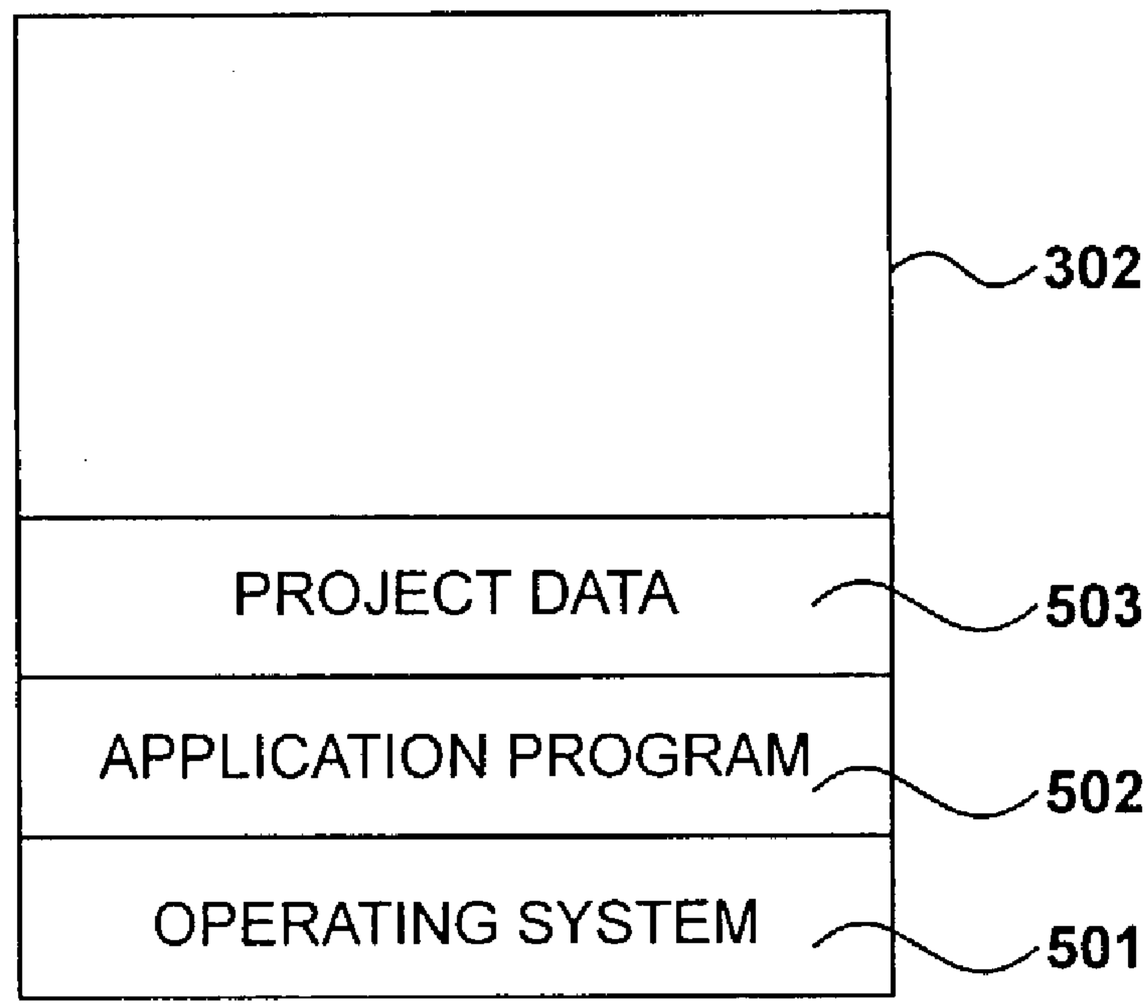


Figure 5A

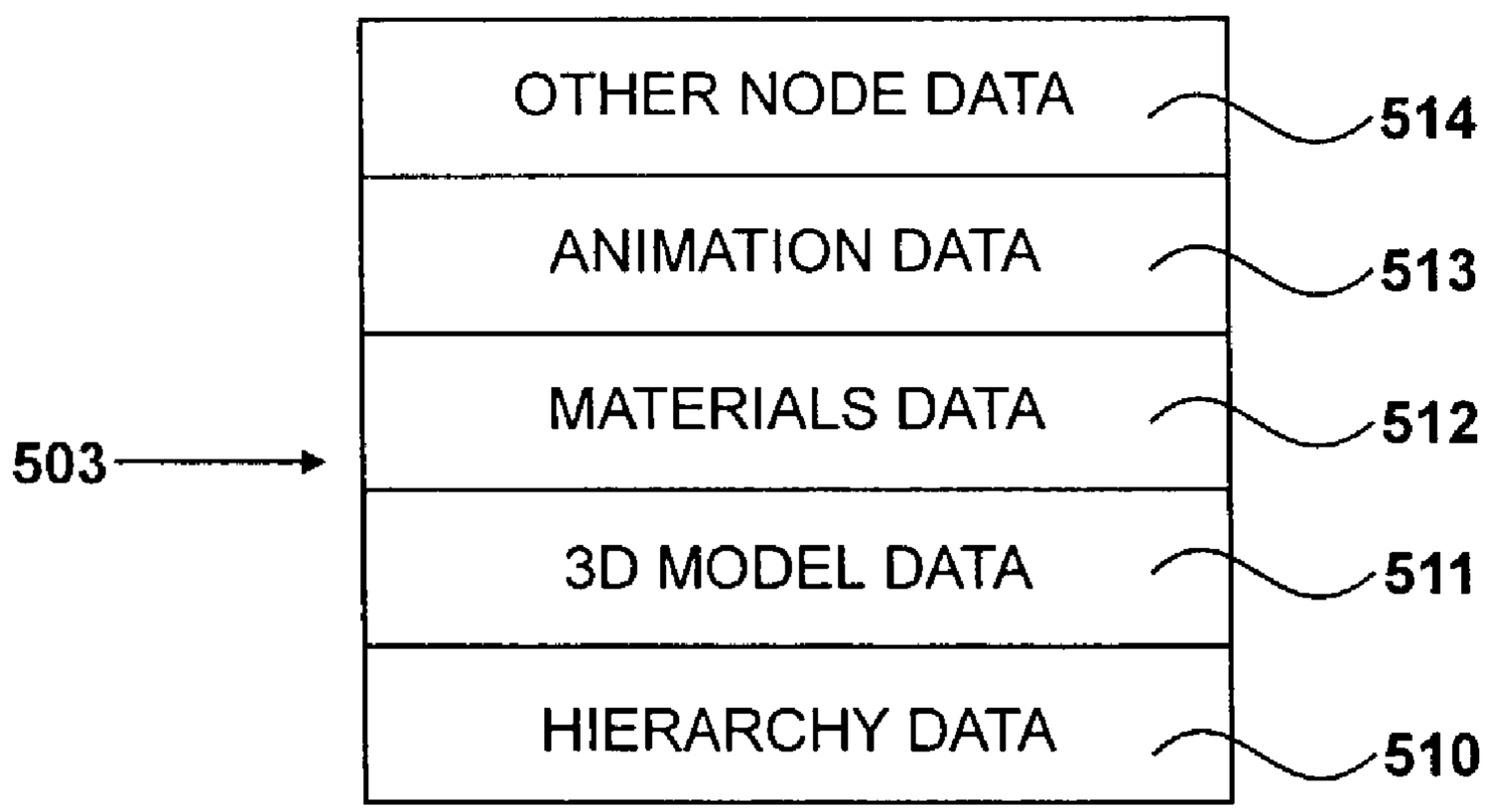
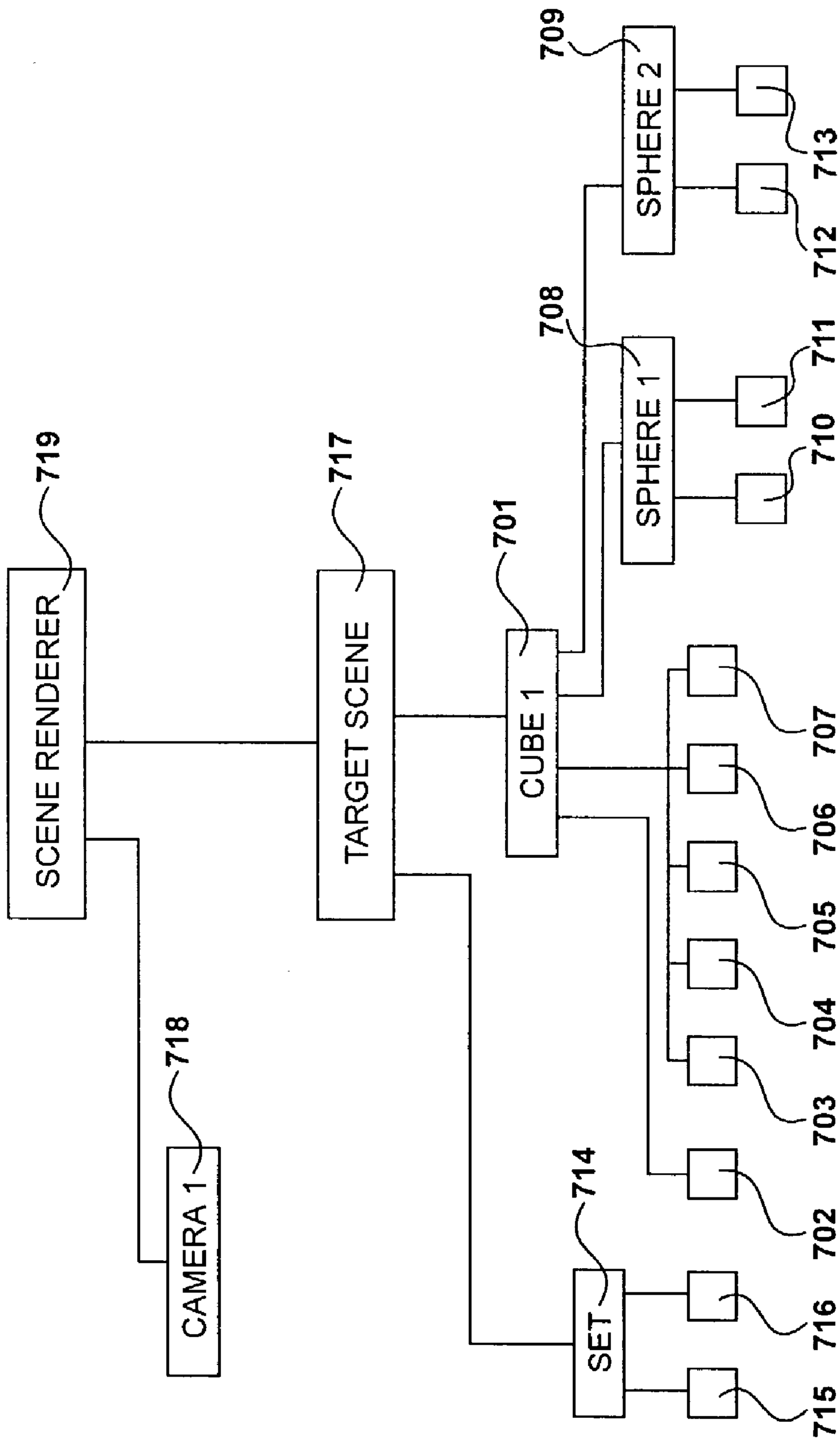


Figure 5B

NODE ID	NODE LABEL	PARENT OF	CHILD OF
1	SCENE RENDERER	2; 3	-
2	TARGET SCENE	4; 5	1
3	CAMERA 1	-	1
4	SET	8; 9	2
5	CUBE 1	6; 7; 10; 11; 12; 13; 14; 15	2
6	SPHERE 1	11; 16	5
7	SPHERE 2	14; 17	5
8	LIGHT 1	-	4
9	TEXTURE - BLACK 009	-	4
10	ANIMATION - SPIN 5	-	5
11	TEXTURE - WHITEHOUSE	-	5; 6
12	TEXTURE - BATTLESHIP	-	5
13	TEXTURE - SPACESHUTTLE	-	5
14	TEXTURE - ASTRONAUT	-	5; 7
15	TEXTURE - PALACE	-	5
16	ANIMATION - ORBIT H	-	6
17	ANIMATION - ORBIT A	-	7

Figure 6



[PRIOR ART]

Figure 7

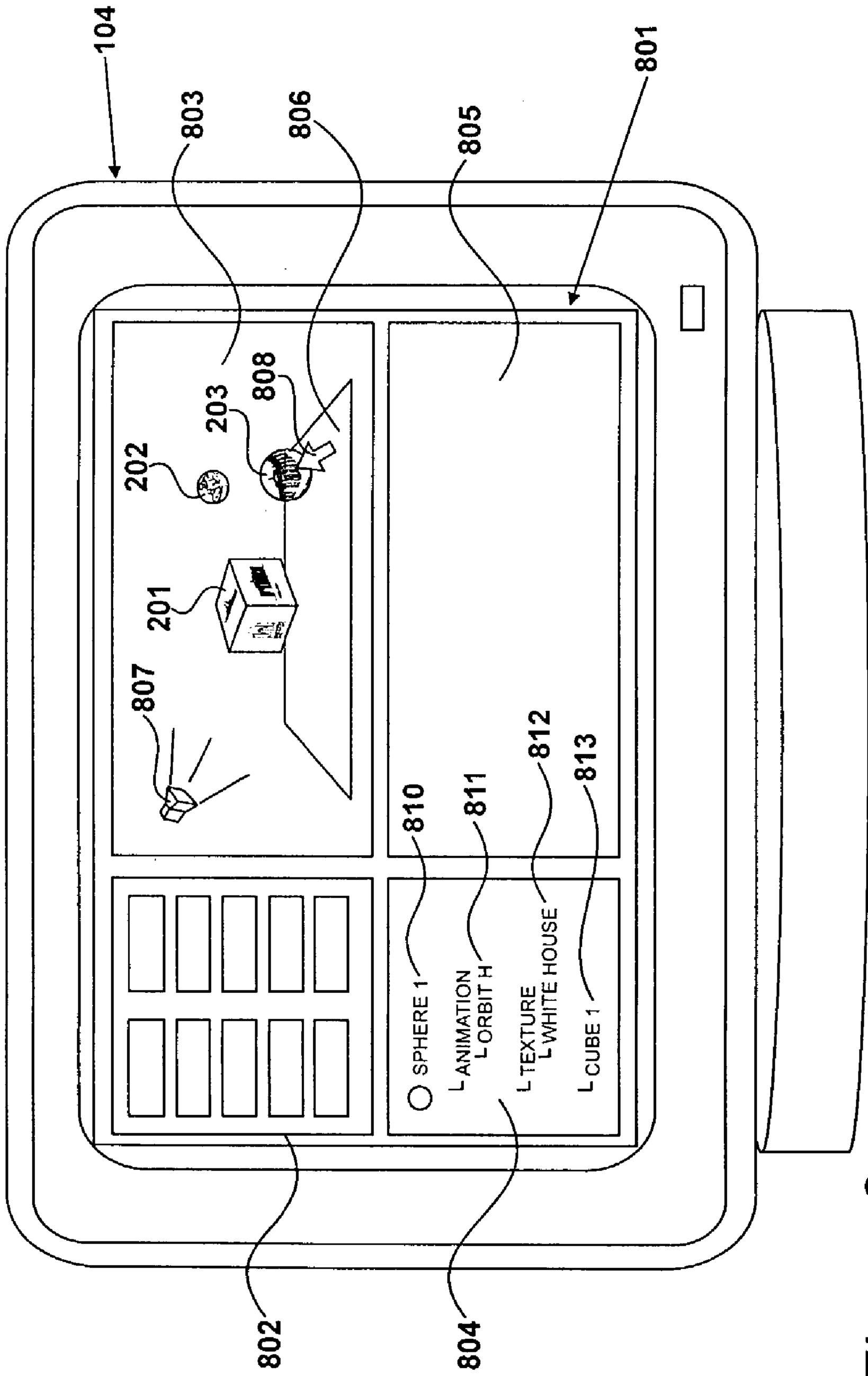

104
803
806
805
801
808
203
202
201
807
810
811
812
813
SPHERE 1
ANIMATION
ORBIT H
TEXTURE
WHITE HOUSE
CUBE 1
802
804

Figure 8

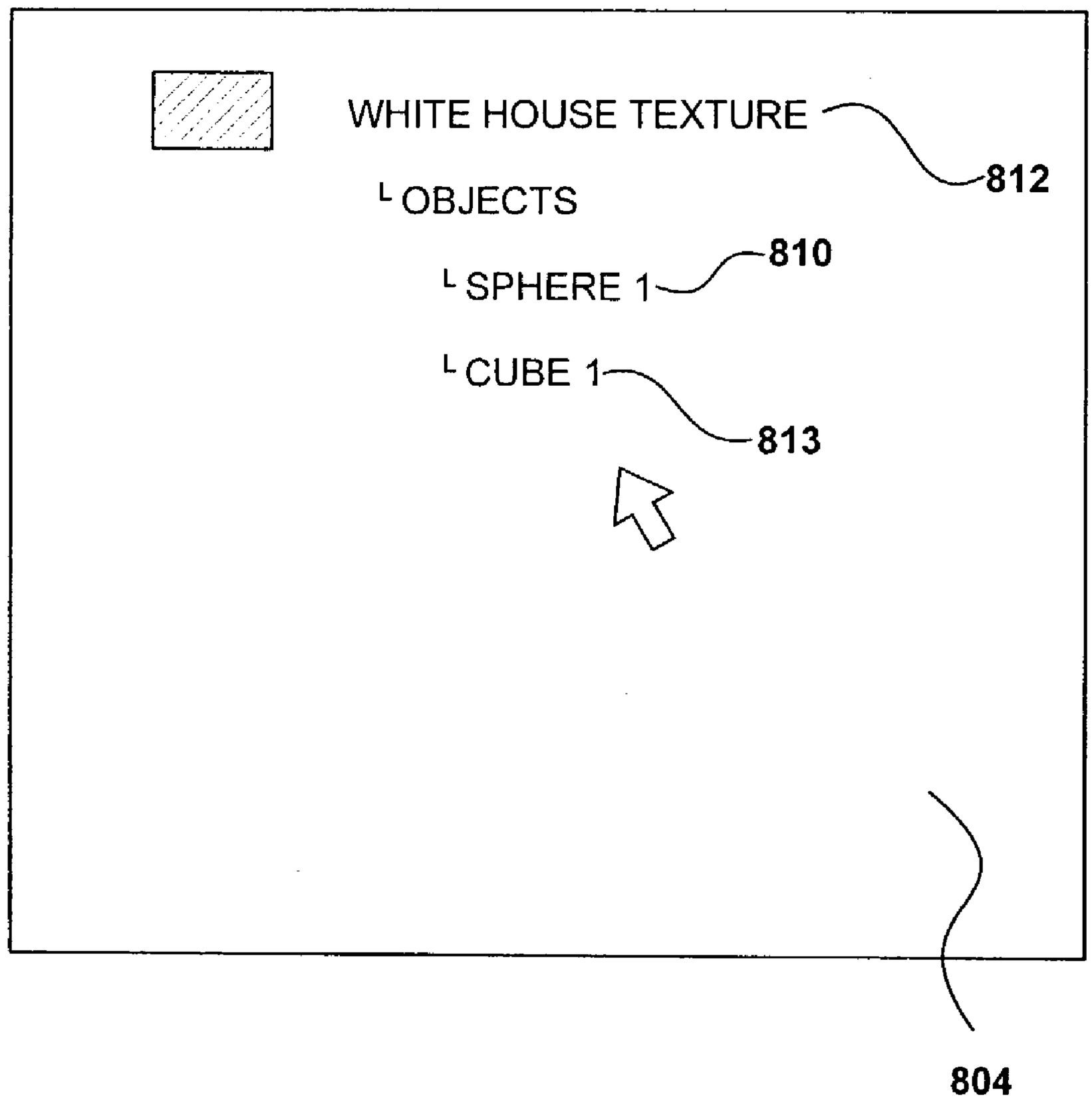


Figure 9

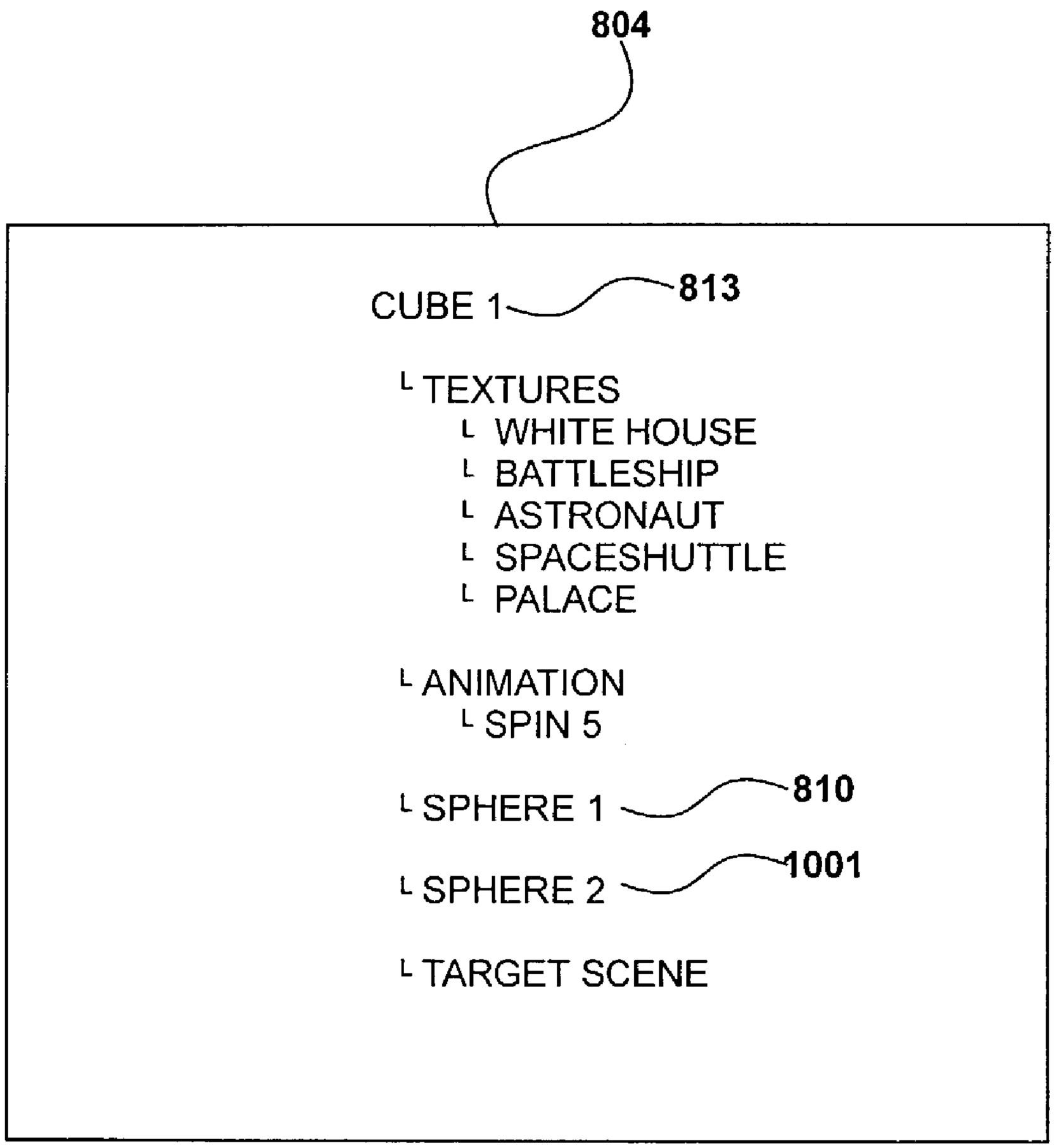

804
CUBE 1
813
TEXTURES
WHITE HOUSE
BATTLESHIP
ASTRONAUT
SPACESHUTTLE
PALACE
ANIMATION
SPIN 5
SPHERE 1
810
SPHERE 2
1001
TARGET SCENE

Figure 10

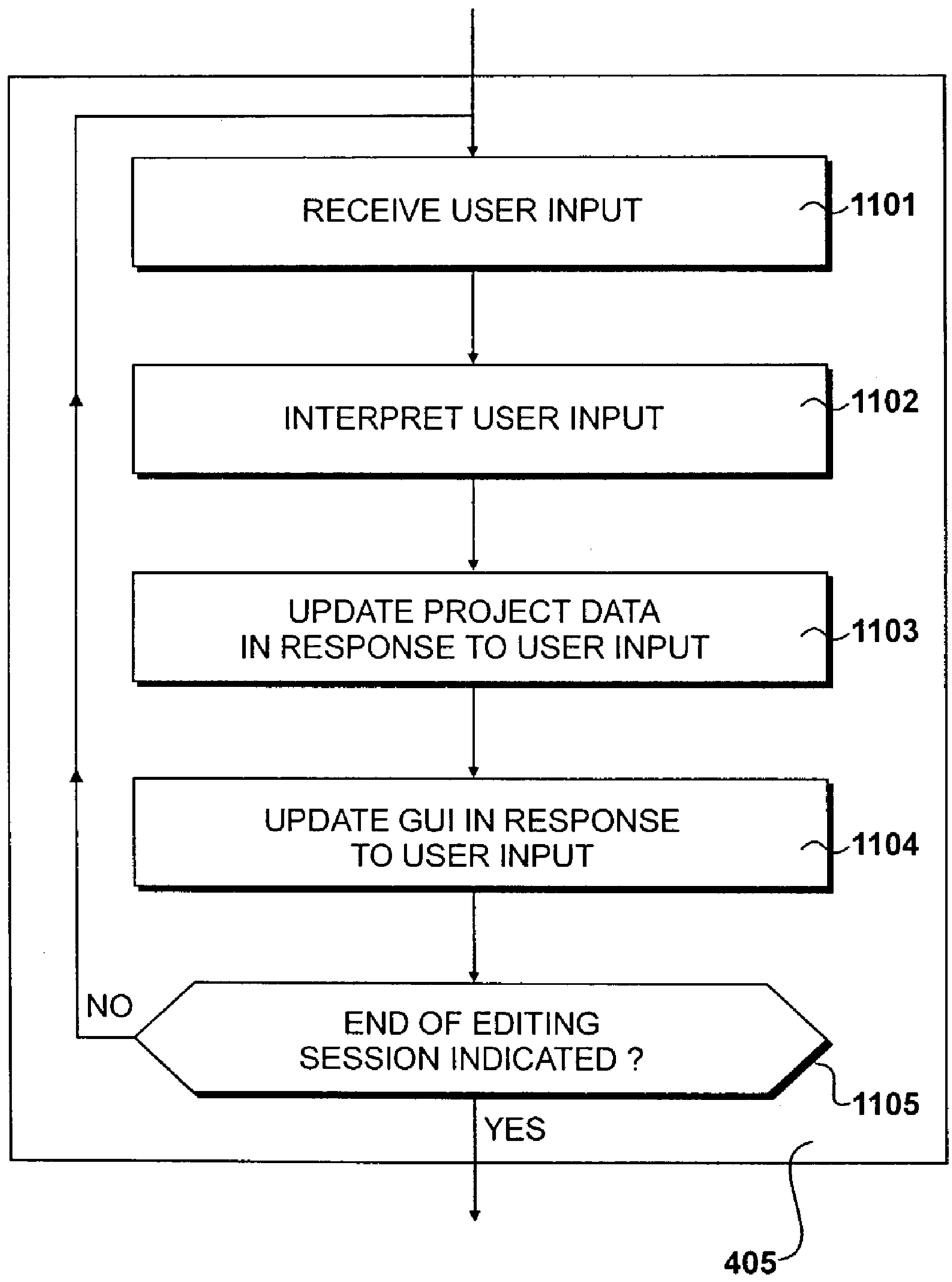

RECEIVE USER INPUT
1101
INTERPRET USER INPUT
1102
UPDATE PROJECT DATA
IN RESPONSE TO USER INPUT
1103
UPDATE GUI IN RESPONSE
TO USER INPUT
1104
NO
END OF EDITING
SESSION INDICATED ?
1105
YES
405

Figure 11

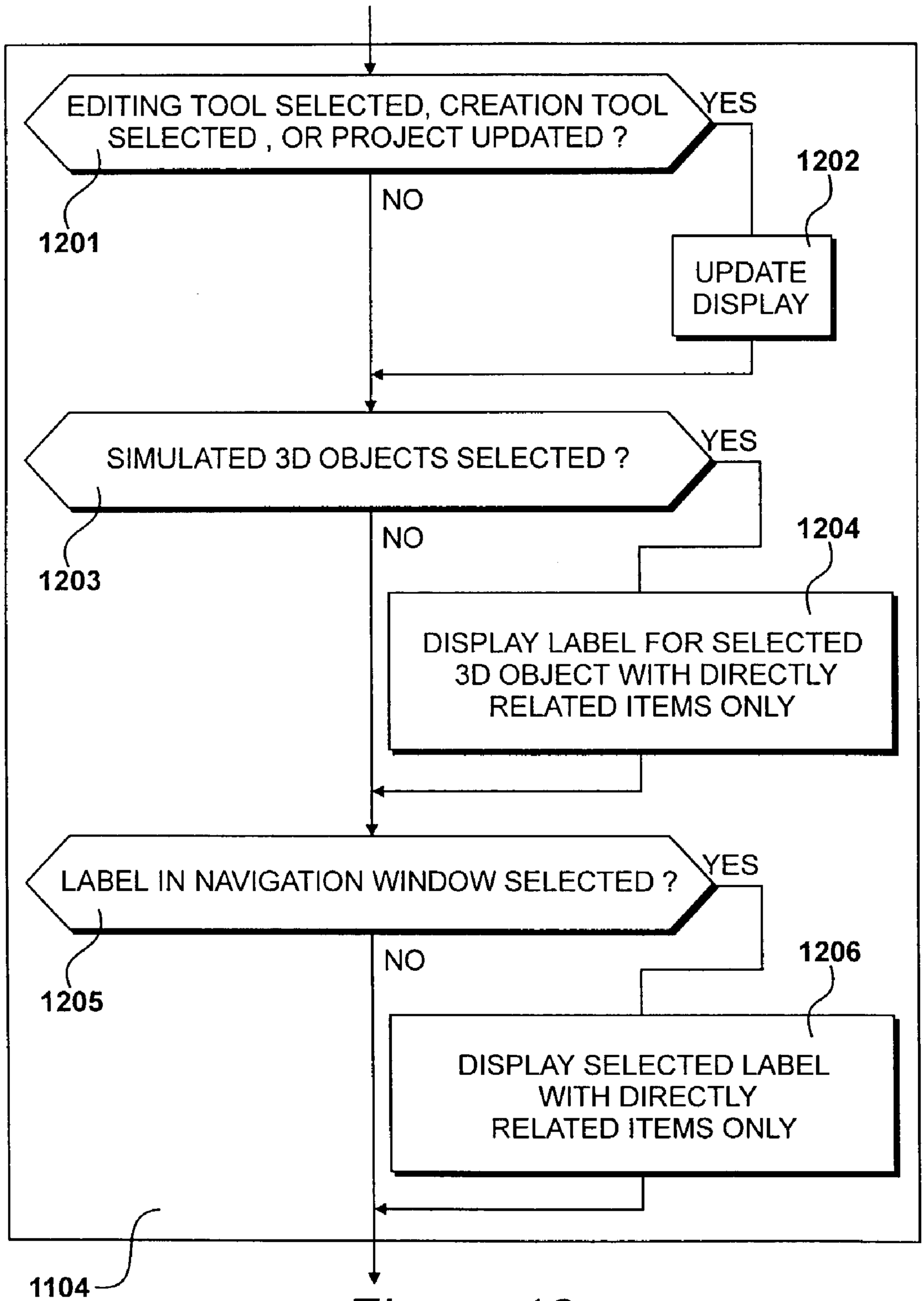

EDITING TOOL SELECTED, CREATION TOOL SELECTED , OR PROJECT UPDATED ?
YES
NO
1201
1202
UPDATE DISPLAY
SIMULATED 3D OBJECTS SELECTED ?
YES
NO
1203
1204
DISPLAY LABEL FOR SELECTED 3D OBJECT WITH DIRECTLY RELATED ITEMS ONLY
LABEL IN NAVIGATION WINDOW SELECTED ?
YES
NO
1205
1206
DISPLAY SELECTED LABEL WITH DIRECTLY RELATED ITEMS ONLY
1104

Figure 12

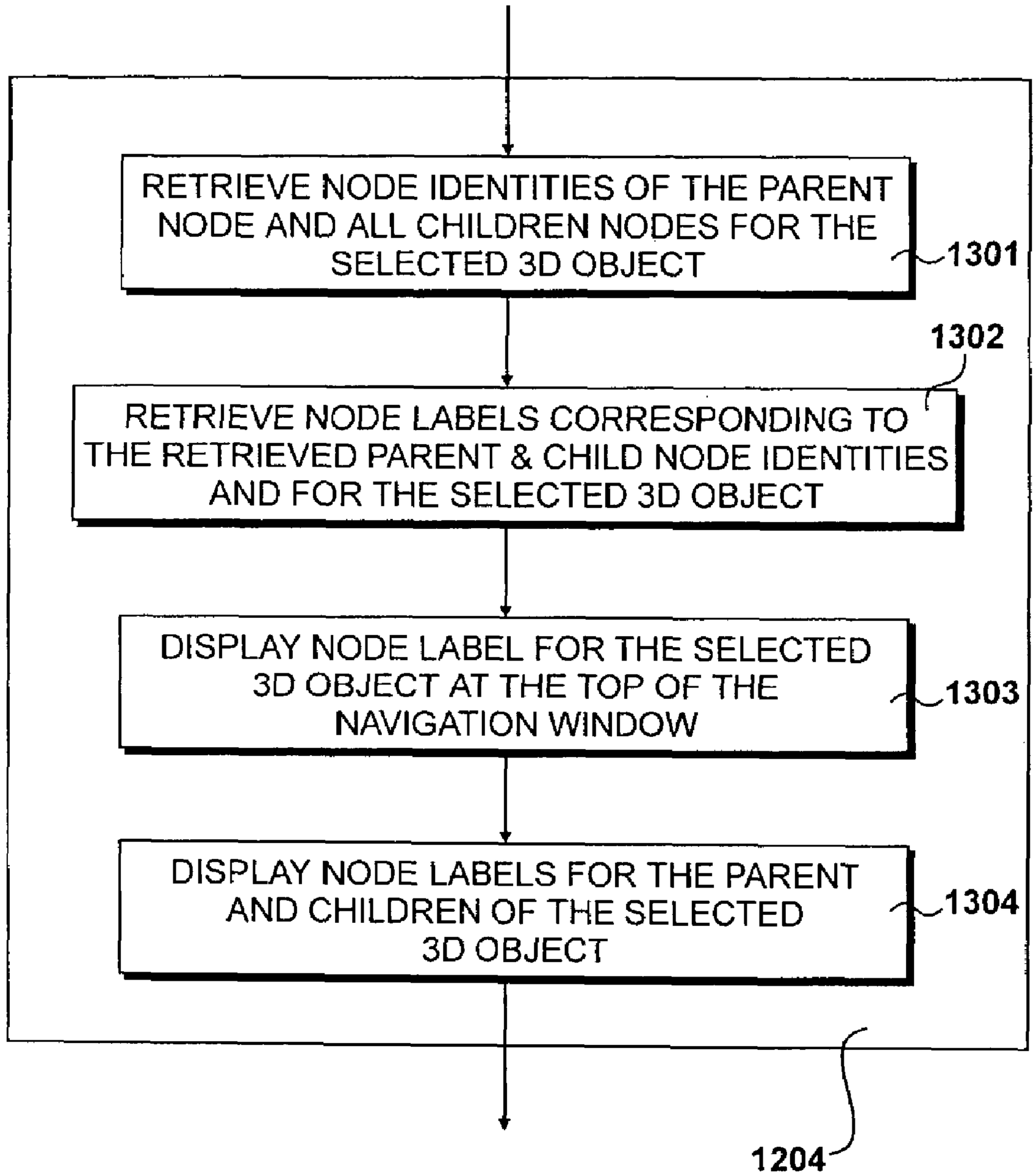

RETRIEVE NODE IDENTITIES OF THE PARENT NODE AND ALL CHILDREN NODES FOR THE SELECTED 3D OBJECT
1301
1302
RETRIEVE NODE LABELS CORRESPONDING TO THE RETRIEVED PARENT & CHILD NODE IDENTITIES AND FOR THE SELECTED 3D OBJECT
DISPLAY NODE LABEL FOR THE SELECTED 3D OBJECT AT THE TOP OF THE NAVIGATION WINDOW
1303
DISPLAY NODE LABELS FOR THE PARENT AND CHILDREN OF THE SELECTED 3D OBJECT
1304
1204

Figure 13

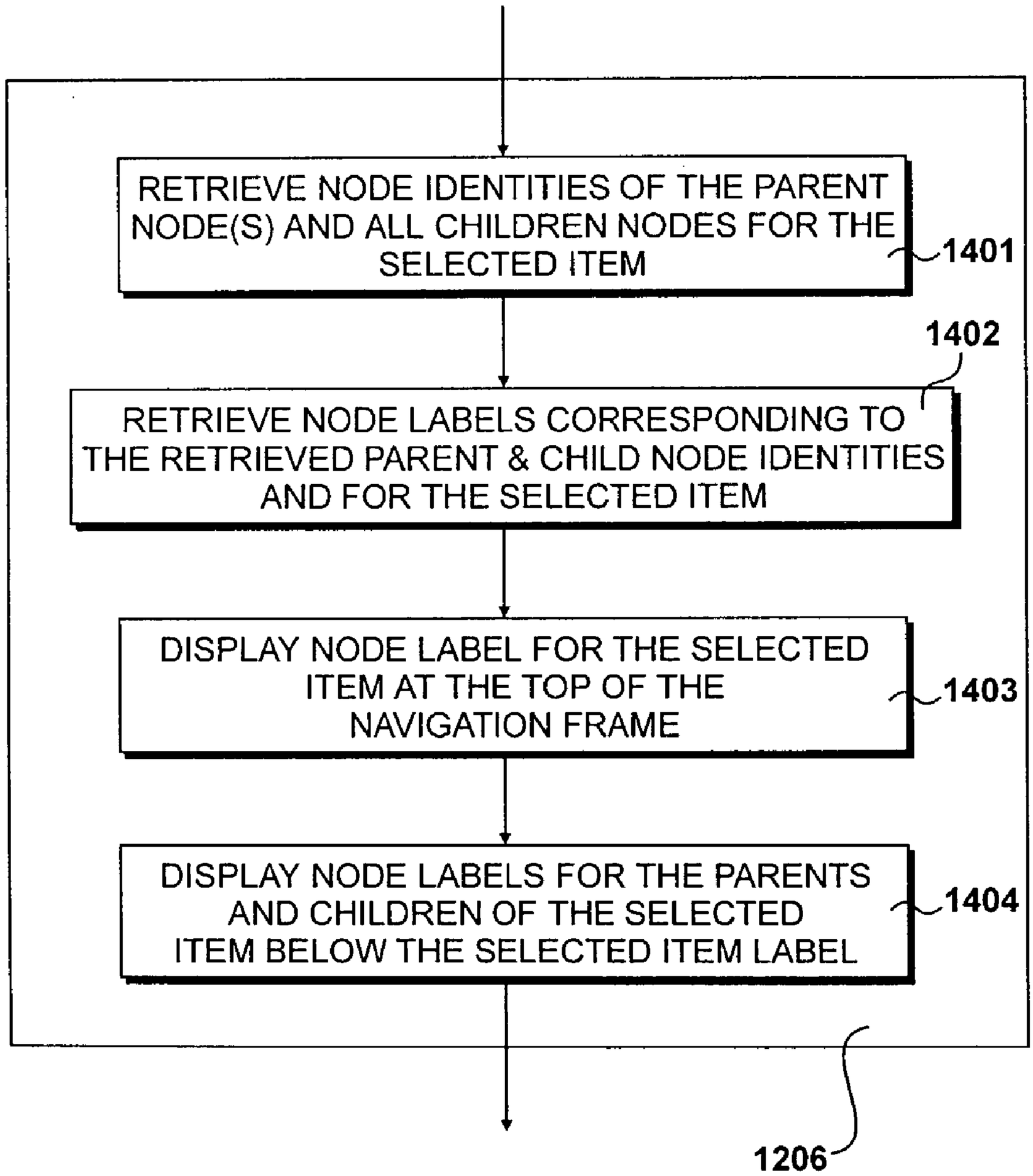

RETRIEVE NODE IDENTITIES OF THE PARENT NODE(S) AND ALL CHILDREN NODES FOR THE SELECTED ITEM
1401
1402
RETRIEVE NODE LABELS CORRESPONDING TO THE RETRIEVED PARENT & CHILD NODE IDENTITIES AND FOR THE SELECTED ITEM
DISPLAY NODE LABEL FOR THE SELECTED ITEM AT THE TOP OF THE NAVIGATION FRAME
1403
DISPLAY NODE LABELS FOR THE PARENTS AND CHILDREN OF THE SELECTED ITEM BELOW THE SELECTED ITEM LABEL
1404
1206

Figure 14

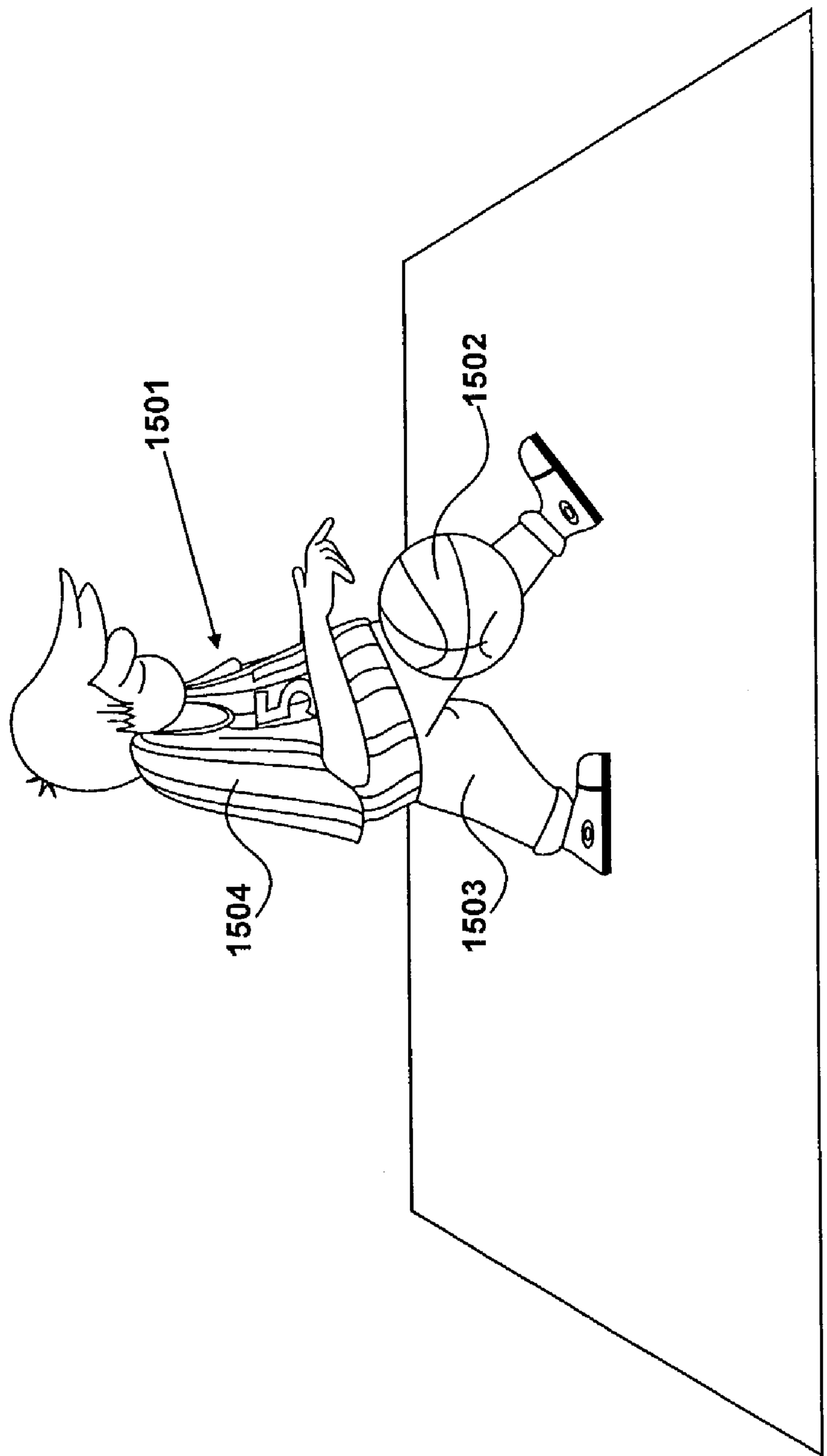
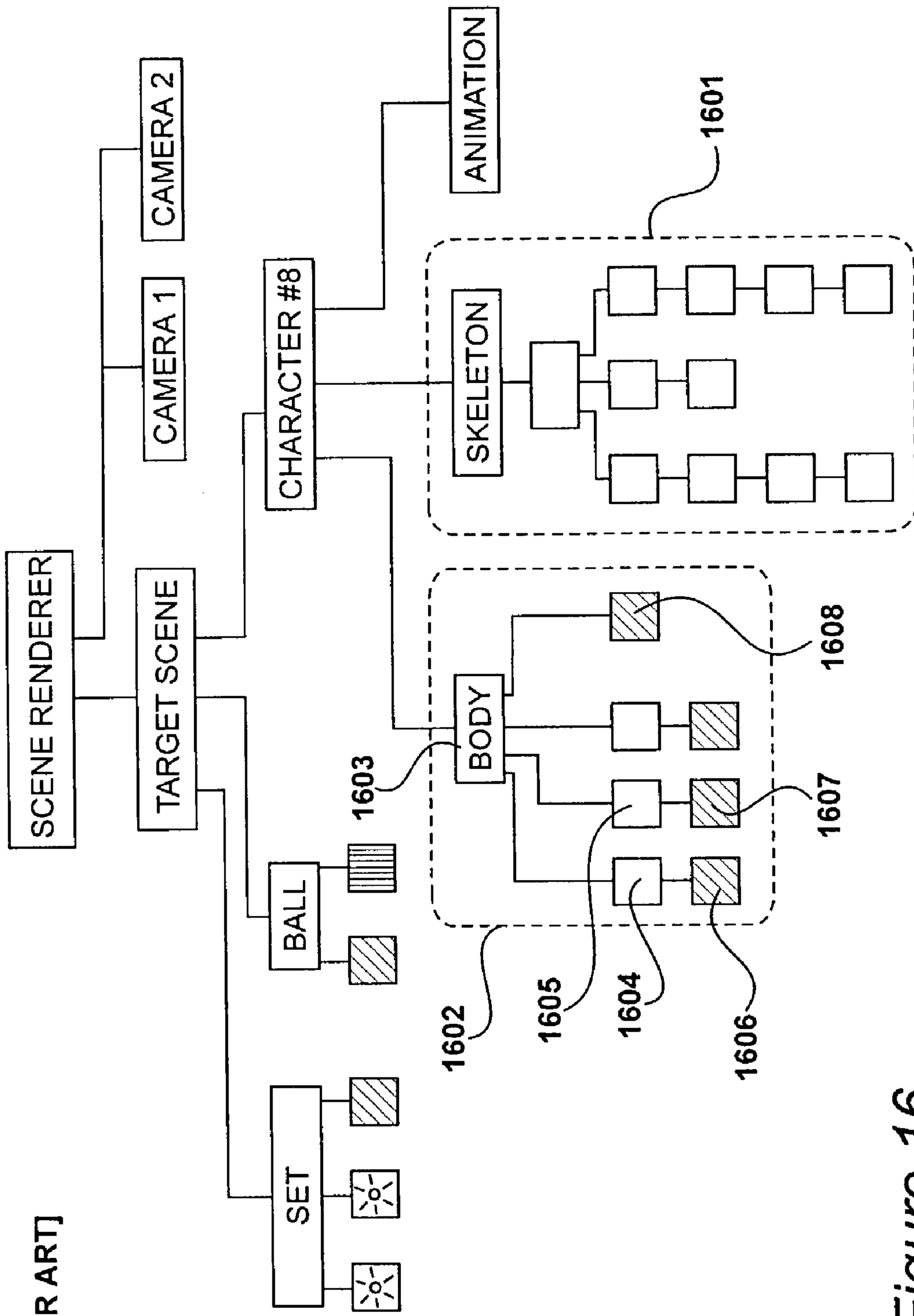


Figure 15



[PRIOR ART]

Figure 16

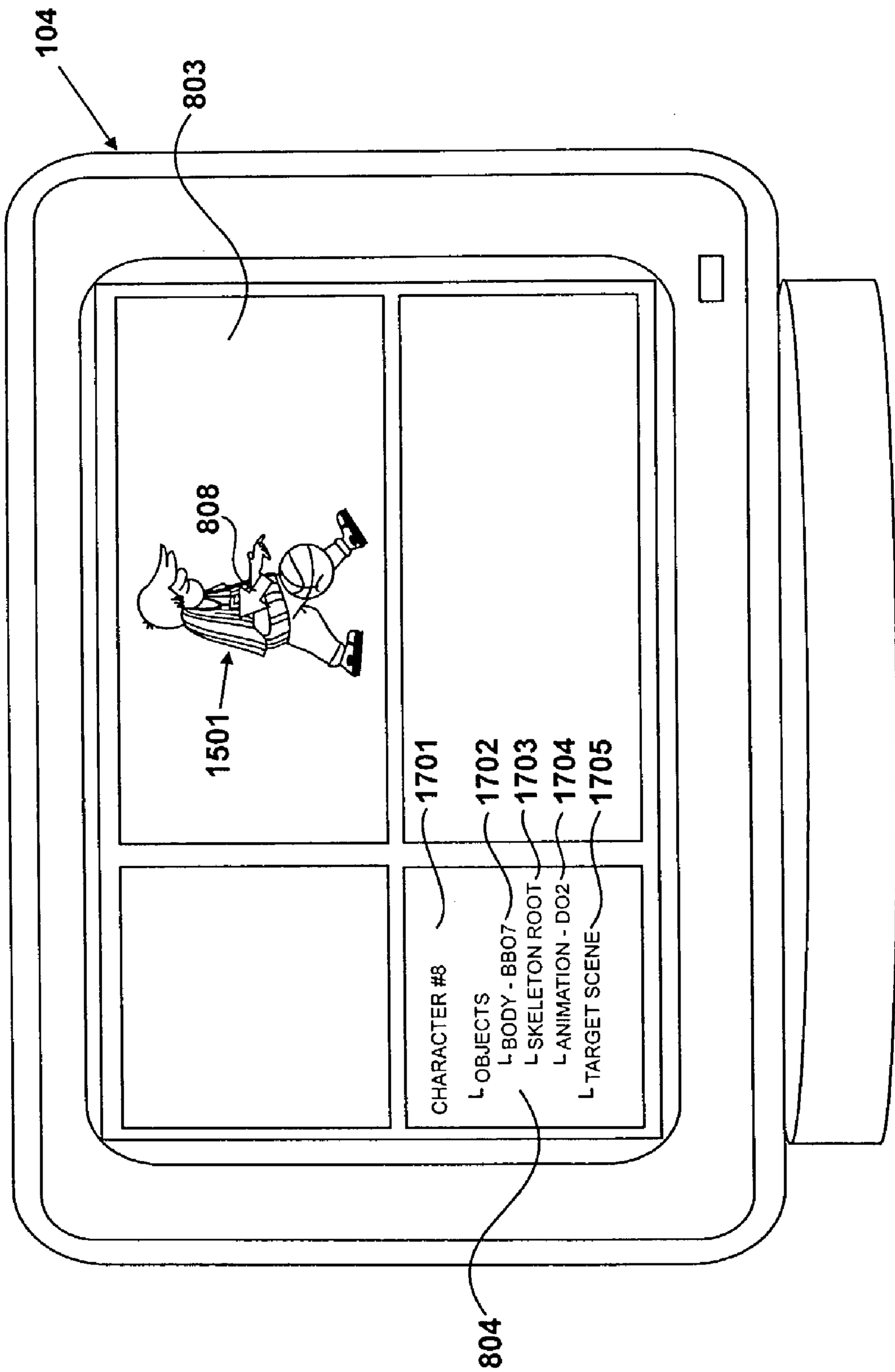

104
803
808
1501
1701
1702
1703
1704
1705
CHARACTER #8
OBJECTS
BODY - BBO7
SKELETON ROOT
ANIMATION - DO2
TARGET SCENE
804

Figure 17

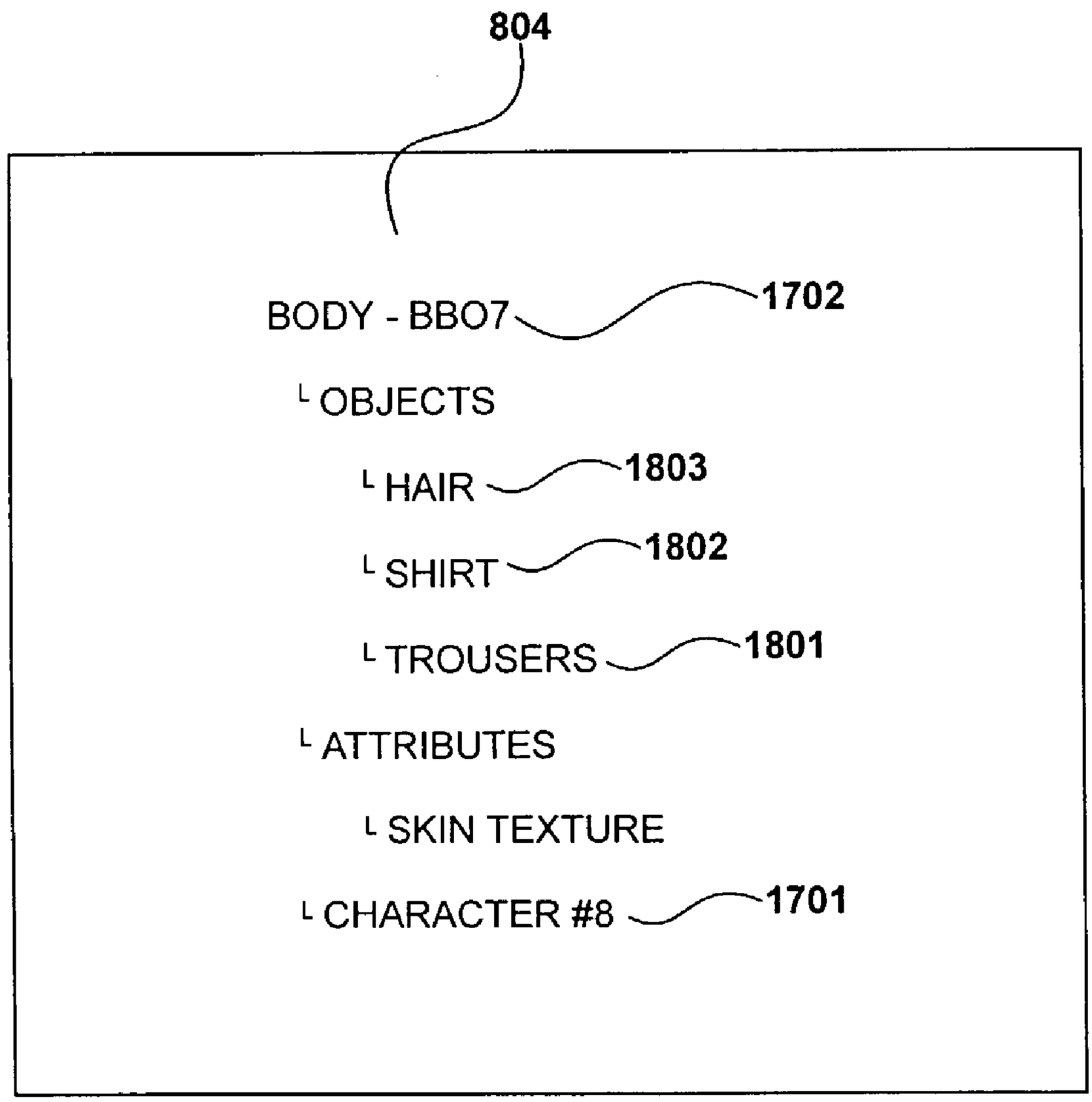

804
BODY - BBO7
1702
OBJECTS
HAIR
1803
SHIRT
1802
TROUSERS
1801
ATTRIBUTES
SKIN TEXTURE
CHARACTER #8
1701

Figure 18

ANIMATION EDITING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to animation editing apparatus for editing animation data, and a method of editing animation data in a data processing system.

2. Description of the Related Art

Computerised systems for the editing of animation data have been used for some time. In order to provide a human editor access to the required editable parameters of an animation, it is known for such systems to display a hierarchical representation of items defining a whole scene. The problem with this approach, is that for a complex, high resolution scene, the editor may be confronted with a hierarchy containing thousands of items representing hundreds of simulated objects and their associated attributes.

BRIEF SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided animation editing apparatus for editing animation data, said apparatus comprising data storage means, processing means, visual display means and manually responsive input device configured to allow a user to indicate a selected point on the visual display means, wherein: said visual display means is configured to display an image representing a simulated three-dimensional world-space including a plurality of simulated objects; said manually responsive input device is configured to provide an input signal indicating a location within said image corresponding to one of said simulated objects; said processing device is configured to identify the selected simulated object in response to receiving said input signal, and to retrieve data from said data storage means of one or more related items related to said selected simulated object within a defined degree of relationship; and said visual display means is configured to display labels identifying the selected simulated object and said related items only.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** shows an animation artist **101** equipped with a computer system **102** for editing animated graphics;

FIG. **2** shows an example of an animation to be edited by the user **101**;

FIG. **3** shows details of computer system **102**;

FIG. **4** shows a flow chart outlining the operation of the system **102**;

FIGS. **5**A and **5**B show data contained within main memory **302** following step **404** of FIG. **4**;

FIG. **6** shows a table representing a database containing hierarchy data **510**;

FIG. **7** shows a scene tree according to the prior art;

FIG. **8** shows a graphical user interface (GUI) **801** produced by the application program and displayed on the visual display unit **104**;

FIG. **9** shows the navigation window **804** after user selection of the label for the Whitehouse texture;

FIG. **10** shows the navigation window **804** after selection of the "CUBE1" label **813**;

FIG. **11** shows the step **405** of editing project data in greater detail;

FIG. **12** shows more detail of the step **1104** of updating the user interface;

FIG. **13** shows further detail of the step **1204** of displaying labels for selected simulated object and directly related objects;

FIG. **14** shows further detail of the step **1206** of displaying a selected label with directly related items;

FIG. **15** shows a second example of an animation project to be edited by the user **101**;

FIG. **16** shows a conventional scene tree representing the animation of FIG. **15**;

FIG. **17** shows the visual display unit **104** as it appears during editing of the animated character **1501**; and

FIG. **18** shows the navigation window **804** after the user has double clicked on the label "BODY-BB07" **1702**.

BEST MODE FOR CARRYING OUT THE INVENTION

FIG. **1**

An animation artist **101** equipped with a computer system **102** for editing animated graphics is shown in FIG. **1**. The artist **101** inputs signals to the computer system **102** by manual operation of a mouse **103**, while viewing a graphical user interface on a visual display unit **104**. In response to receiving the input signals from the mouse **103**, the system **102** performs functions including: editing animation data; presenting selected editing tools on the user interface; and presenting representations of selected items to be edited.

As an alternative to using a mouse **103**, the artist **101** could be provided with a stylus/touch-tablet combination, or a trackball or similar manually responsive input device.

FIG. **2**

An example of an animation to be edited by the user **101** is shown in FIG. **2**. The animation comprises three simulated three dimensional objects **201**, **202** and **203** within a simulated three dimensional world-space. The first of the simulated objects is a cube **201** which is animated such that it rotates about a vertical axis passing through its upper face **204**, while apparently making movements towards the viewer. Consequently, during the animation, five of its six faces may be viewed. A bit map image has been texture mapped onto each of the five viewable faces, and thus, for example face **204** appears to comprise a two dimensional image of a battleship, while faces **205** and **206** comprise images of a spaceshuttle and the Whitehouse respectively. The two remaining simulated objects **202** and **203** are spheres which are animated such that they appear to rotate about the cube **201**, in a similar manner to satellites orbiting a planet. The spheres have also had bit map images mapped onto their surfaces, so that sphere **203** supports the same image as cube face **206**, while sphere **202** supports the same image as one of the other cube faces presently not viewable.

FIG. **3**

Computer system **102** is detailed in FIG. **3**. It includes a central processing unit **301** such as an Intel Pentium **4** processor or similar. Central processing unit **301** receives instructions from memory **302** via a system bus **303**. On power-up, instructions are read to memory **302** from a hard disk drive **304**. Programs are loaded to the hard disk drive **304** by means of a CD-ROM received within a CD ROM drive **305**. Output signals to the display unit are supplied via a graphics card **306** and input signals from the mouse **103**, similar devices and a keyboard are received via input card **307**. The system also includes a zip drive **308** and a network card **309**, each configured to facilitate the transfer of data into and out of the system.

The present invention is embodied by an animation editing program installed from a CD ROM **310** via the CD-ROM drive **305**.

FIG. **4**

A flow chart outlining the operation of the system **102** is shown in FIG. **4**. Following the system **102** being switched on at step **401**, instructions are loaded from the hard disk drive **304** into main memory **302**, at step **402**. Upon completion of the loading operation at step **402**, the application starts at step **403**, and a graphical user interface for editing animation projects is initialised. At step **404**, existing project data is loaded into memory such that it may be edited at step **405**. The updated project data is then stored at step **406**. At step **407** it is determined whether or not a further project is to be edited, and if so, steps **404** to **407** are repeated. Otherwise, the system is shut down at step **408**.

FIGS. **5**A and **5**B

Data contained within main memory **302** following step **404** is shown in FIG. **5**A. Thus following the loading steps **402** and **404**, the memory **302** contains an operating system **501**, which may be for example Windows or Linux, the application program **502** by which animated graphics may be edited as described below, and project data **503** defining the particular animation being edited.

The project data **503** is illustrated in greater detail in FIG. **5**B. The project data comprises: hierarchy data **510**; three-dimensional model data **511**; materials data **512**; animation data **513** and other node data **514**. The three-dimensional model data **511** defines the geometry of simulated objects appearing in the graphic. Thus, for example, during editing of the animation of FIG. **2**, the model data **511** comprises data defining the shape and dimensions of objects **201**, **202** and **203**. Materials data **512** comprises data defining colours, textures or patterns appearing in the animation, such as the Whitehouse, battleship, spaceshuttle, and Astronaut textures used in the animation of FIG. **2**. The animation data **513** defines the simulated three-dimensional movement of the simulated objects appearing in the animation. Thus, for example, animation data **513** may define the manner in which the cube **201** rotates and the manner in which the spheres **202** and **203** orbit the cube. Other node data **514** defines other characteristics of the animation, such as: the set in which the simulated objects appear; the lights; the cameras; etc.

The hierarchy data **510**, defines relationships existing between items defined by data **511**, **512**, **513** and **514**. Thus, the hierarchy data **510**, defines relationships between simulated objects defined by data **511**, material items defined by data **512**, animations defined by data **513**, and lights, cameras etc. defined by data **514**.

FIG. **6**

The hierarchy data may be stored within the memory of the system **102** as a database. A table representing a database containing hierarchy data **510** is shown in FIG. **6**. Each item defining an animation is provided with a node label, suitable for identifying the item to a user such as artist **101**, and a node identity.

The example provided in FIG. **6** corresponds to the animation of FIG. **2**. Thus, there are three items given the node labels "CUBE1", "SPHERE1" and "SPHERE2" defining the simulated cube **201** and spheres **202** and **203**. There are also five items, with node identities **11**, **12**, **13**, **14** and **15**, defining textures, and three items with node identity **10**, **16** and **17** defining the animation of the three simulated objects. One light and one camera have been defined for the present animation and these are identified by node identities **8** and **3**.

Two other items labelled "target scene" and "scene renderer" are also included in the database. The "target scene" defines the overall composition of the animation. The "scene renderer" is a process for rendering the three dimensional animation, defined by the target scene, into a two dimensional animated image that is suitable for display.

It should be understood that an item may be a data-set, or a process which defines a part of an animation, such as a simulated object, an attribute of an object, the overall composition of the animation or the rendering of the animation.

The relationships existing between the items of the database are illustrated by the third column, "PARENT OF" and fourth column "CHILD OF" of the table. The two relationships are the opposite of each other, and thus, if item "A" is a parent of item "B", then item "B" is a child of item "A". For example, the sixth line shows that "SPHERE1" is the parent of "Texture-Whitehouse" (node identity **11**) and "Animation-Orbit H" (node identity **16**), while line **11** shows that "Texture-Whitehouse" is a child of "SPHERE1" (node ID **6**) and line **16** shows that "Animation-Orbit H" is a child of "SPHERE1" (node ID **6**). Thus the attributes of objects are children of the object.

The two spheres, "SHERE1" and "SHERE2" have been constrained to the object "CUBE1" such that they follow the movement of "CUBE1" during the animation. An offset constraint is used so that the spheres are held apart from "CUBE1". Because the spheres are constrained to "CUBE1", they are its children, as indicated in FIG. **6**.

The database therefore contains data indicating which items are directly related and the nature of the relationship, that is, "parent of" or "child of". The database is therefore designed such that given the node identity of an item, the node identities of its children may be looked up in the third column, or its parent may be looked up in the fourth column.

FIG. **7**

A scene tree according to the prior art is shown in FIG. **7**. Scene trees provide a graphical representation of the hierarchical structure of items defining an animation. Conventional editing systems provide such a scene tree to allow an artist such as artist **101** to identify and edit parameters of an animation.

The scene tree of FIG. **7** illustrates the animations items and relationships shown in the table of FIG. **6**. Thus, cube **201** is represented by an node **701** which has lead-lines down to nodes **702**, **703**, **704**, **705**, **706**, **707**, **708** and **709** representing respectively the animation and the five textures applied to the cube **201**, and the spheres **202** and **203**. Similarly, spheres **202** and **203**, represented by nodes **708** and **709**, have associated attributes represented by nodes **710** and **711**, and **712** and **713** respectively. A node **714** is used to represent the set and this has lead-lines down to nodes **715** and **716** representing the texture applied to the set and the light applied to the set.

Lead-lines drawn up from the set **714** and cube **701** to another node **717**, representing the target scene, indicate that the target scene is the parent of said set, and cube. Lead-lines from the node **717** and a node **718** representing a defined camera, "CAMERA1", up to scene renderer node **719** show that the scene renderer is the parent of said camera and the target scene.

The graphical animation illustrated in FIG. **2** is simple, being composed of just three simple objects, and yet the corresponding scene tree, shown in FIG. **7**, has nineteen nodes. In animations which are more complex, for example containing many human characters or animals, scene trees have been known to contain hundreds and in some cases

thousands of nodes. It will therefore be understood that a user such as artist **101**, will have difficulties in navigating around the scene tree in such cases.

In contrast, as described below, the system **102** provides a user interface which allows its user to navigate around the objects of a scene and related attributes in such a way that only items closely related to a user selected item are displayed. The user is therefore presented with only information which is relevant to their present interest, and only of a limited volume, thus making it relatively easy to comprehend when compared to the scene tree of FIG. **7**.

Furthermore, the animation editing system **102** preferably includes character registration mapping as described in the applicants co-pending Canadian patent application published as CA 2 314 712. It has been found that the character registration mapping in combination with the features of the graphical user interface described herein allows a user to perform animation editing without the need to refer to a scene tree, such as that shown in FIG. **7**.

Another point to note from FIG. **7** is that although the textures applied to the spheres **202** and **203** are the same as two of the textures applied to the cube **201**, there is no indication of this in the scene tree. This can be a problem in more complex animations where, for example, attributes such as colours and textures are applied to several objects but, due to the complexity of the scene, it is not apparent to the artist. For example, an artist may edit the parameters of an attribute applied to an object, not realising that they are also editing an attribute of other objects.

FIG. **8**

A graphical user interface (GUI) **801** produced by the application program and the GUI is displayed on the visual display unit **104** shown in FIG. **8**. The user interface **801** includes four windows: an icon window **802**, a viewer window **803**, a navigation window **804** and a tool window **805**. The viewer window **803** contains a two dimensional representation of the three-dimensional animation which is to be edited. Thus, in the present example, the viewer window **803** contains a virtual floor **806**, upon which the cube **201**, and the two spheres **202** and **203** are arranged. In addition, the viewer window **803** also contains a virtual directional light which appears to illuminate the objects **201**, **202** and **203**. The viewer window **803** also presently contains the cursor **808** which may be moved across the whole display by means of the mouse **103**.

The icon window **802** contains a number of icons which facilitate the creation of new simulated objects, the addition of materials to objects within the scene, the animation of objects within the scene, etc.

The navigation window **804** displays a number of labels representing selected items defining the animation. The particular items displayed by the navigation window are selected by the application program in response to the user's input. Specifically, when the system receives an input indicating that a simulated object in viewer window **803** has been selected by the user, the system displays a label representing said selected object at the top of the navigation window **804**, and then displays labels representing other items which are directly related to the selected simulated object.

"Directly related" is herein defined as meaning "being a parent of, or being a child of". Thus if two items are directly related, then one is a child of the other, and when a simulated object is selected by the user, labels representing said object, the child or children of said object and the parent of said object are displayed in the navigation window.

For example, in FIG. **8**, the user **101** has double clicked the mouse with the cursor **808** over the sphere **203** in window **803**, in order to indicate to the system that the sphere **203** is to be represented in the navigation window **804**. Therefore, a label **810** representing sphere **203**, labels **811** and **812** representing its attributes and another label **813** representing its parent, "CUBE1", are displayed in window **804**.

The user **101** is therefore presented with only the portion of the hierarchical structure that they are interested in, rather than being confronted with the whole scene tree.

The application selects suitable tools for editing the selected item and displays said tools within window **805**.

After selecting a particular simulated object the user may then selected another such object by clicking on the relevant object in viewer window **803**. Alternatively, the user may navigate around the hierarchy structure by clicking on labels displayed in the navigation window **804**. For example, the user could view the items directly related to the cube **201** by clicking on the label "CUBE1" **813**, or if they wished to edit the texture applied to the sphere **203** they could click on the label **812**.

The application program is therefore structured such that if the system receives an input indicating that a label within the navigation window has been selected, it displays the selected label at the top of the navigation window and displays labels of directly related items below it. An example of this functionality is provided by FIG. **9**.

FIG. **9**

FIG. **9** illustrates the navigation window **804** after a user selection of the label for the Whitehouse texture. By clicking on the Whitehouse texture label **812** in FIG. **8**, the user indicates to the system that the Whitehouse texture is to be selected. Thus as shown in FIG. **9**, the Whitehouse label **812** is repositioned at the top of the navigation window **804** to identify the Whitehouse label **812** as the selected item, and labels representing items directly related to said texture are displayed below it. Therefore, window **804** displays labels **810** and **813** representing the simulated objects sphere **203** and cube **201**, making it clear to the user that the Whitehouse texture is used on both the sphere **203** and the cube **201**.

The windows **802** and **803** remain unchanged in appearance, and so continue to display creation tool icons and a view of the animation. While window **805** is updated to display appropriate editing tools

If the user now wishes to divert their attention to the cube **201**, they may update the navigation window by selecting the relevant label **813** using the mouse.

FIG. **10**

FIG. **10** shows the navigation window **804** after selection of the "CUBE1" label **813**. Once again the selected item has been positioned at the top of the window **804** and labels of the directly related items are displayed below it. Thus, for example, window **804** displays labels representing the attributes of the selected object, i.e. the cube **201**, and labels **1001** and **810** representing the objects **202** and **203** constrained to said selected object.

FIG. **11**

The processing of data in response to user generated input commands at step **405** of FIG. **4** allows many sophisticated animation techniques to be performed. A portion of the procedures performed, implementing the preferred embodiment of the present invention are illustrated by FIGS. **11** to **14**. The processes are event driven and will respond to event input data generated by the user. In order to respond to an event the

central processing unit **301** responding to interrupts and the animation program, in combination with the operating system, is required.

FIG. **11** shows greater detail of the step **405** of editing project data. Within step **405**, at step **1101**, the system receives an input signal generated by a mouse button click. At step **1102**, the input signal is interpreted. The input signal provides information relating to the two dimensional co-ordinates of the mouse cursor, and these co-ordinates are used in combination with a look-up table to determine what the co-ordinates correspond to. If the co-ordinates fall within the viewer window **803**, it is then determined whether they correspond to a position on the image of a simulated object, and if so, the node identity for the simulated object is identified. If the co-ordinates fall within the navigation window **804**, it is then determined whether a displayed label has been selected, and if so the node identity corresponding to the node label is identified.

Alternatively, if the user input corresponds to the operation of an editing tool or creation tool, project data will be updated at step **1103**. At step **1104**, the graphical user interface is updated in response to the user input. Then at step **1105**, a question is asked to determine whether the end of the editing session has been indicated by the user input, and if so step **405** is completed. Otherwise steps **1101** to **1105** are repeated.

FIG. **12**

The step **1104** of updating the user interface is shown in more detail in FIG. **12**. At step **1201** it is determined whether the user input indicated the selection of an editing tool or creation tool, or if the project was edited at step **1103**, and if so, the display is updated accordingly at step **1202** before step **1203** is performed. Otherwise the process enters step **1203** directly.

At step **1203** a question is asked to determine whether the user input indicated the selection of a simulated three dimensional object, and if so, step **1204** is performed before step **1205**. Otherwise step **1205** is performed directly after step **1203**. At step **1204** node labels are displayed corresponding to the selected simulated object and items directly related to said selected object only. Thus, unlike the prior art illustrated in FIG. **7**, only labels of selected items are displayed and not the whole scene tree.

At step **1205** a question is asked to determine whether the received user input indicated the selection of a label in the navigation window **804**. If this is so, then the selected label is displayed in the navigation window **804** along with labels of directly related items only. Completion of step **1206**, or a negative answer to the question at step **1205** completes step **1104**.

FIG. **13**

The step **1204** of displaying labels for a selected simulated object and directly related objects is shown in further detail in FIG. **13**. Within step **1204**, at step **1301**, using the node identity of the selected simulated object and the database illustrated by example in FIG. **6**, node identities are retrieved for the parent node and all children nodes for the selected simulated object. Having obtained node identities at step **1301**, node labels corresponding to the retrieved parent and child node identities, and for the selected simulated object are retrieved form the database at step **1302**. At step **1303** the node label for the selected simulated object is displayed at the top of the navigation window, and the node labels for its parent and children are also displayed in the navigation window during step **1304**.

In an alternative embodiment, as well as displaying labels of the parent and children of the selected simulated object, the parent of the parent is also displayed. In a further alternative embodiment, as well as displaying labels of the parent and children of the selected simulated object, the children of the children are also displayed. However, in the preferred embodiment and these two alternative embodiments, the system only displays a label for the selected simulated objects and related items within a defined degree of relationship.

FIG. **14**

The step **1206** of displaying a selected label with directly related items is shown in further detail in FIG. **14**. At step **1401**, node identities are retrieved for the parent nodes and all children nodes for the selected item. This is done using the node identity of the selected item, determined at step **1102**, and the database illustrated by example in FIG. **6**. It should be noted that where the selected label corresponds to an attribute, there may be more than one parent item. This was the case in the example of FIG. **9**, where the "Whitehouse" texture had two parent objects, sphere **302** and cube **201**.

Having obtained node identities at step **1401**, node labels corresponding to the retrieved parent and child node identities, and for the selected label are retrieved from the database at step **1402**. At step **1403** the selected node label is displayed at the top of the navigation window **804**, and the node labels for the parents and children are also displayed in the navigation window during step **1404**.

FIG. **15**

A second example of an animation project to be edited by the user **101** is illustrated in FIG. **15**. The animation comprises a three-dimensional cartoon-like character **1501** who bounces a basketball **1502** as he walks along. The character is wearing baggy trousers **1503** and large basketball shirt **1504** which appear to move naturally as the character moves along.

FIG. **16**

A conventional scene tree representing the animation of FIG. **15** is shown in FIG. **16**. Although still quite a simple animation, it is clearly more complex that that of FIG. **2**, and consequently there are thirty-three nodes in the scene tree.

The character comprises a group of simulated objects in the form of an internal skeleton which allows the character to be positioned and animated, and external objects constrained to the skeleton to provide him with a dressed, human-like appearance. Thus the scene tree has a family of nodes, shown within dashed line **1601**, which comprise the skeleton of the character, and other nodes, shown within dashed line **1602**, which comprise its outer body.

As can be seen in FIG. **16**, the skeleton of the character comprises eleven objects referred to as bones. The bones have strict parent-child relationships which determine how the character may be animated using, for instance, forward kinematics, or inverse kinematics.

In this example, the body of the character is formed as a single object and represented by node **1603**. The body is the parent of other objects including the shirt **1504** and trousers **1503**, represented by nodes **1604** and **1605**. The shirt and trousers are constrained to the body, so that their animation is determined by the animation of the body. The shirt and trousers are thus children of the body as illustrated by the scene tree. The shirt, trousers and body each have applied textures as represented by nodes **1606**, **1607** and **1608** respectively.

FIG. **17**

The visual display unit **104**, as it appears during editing of the animated character **1501**, is shown in FIG. **17**. The character **1501** is displayed in the viewer window **803** with the mouse cursor **808** positioned over him. The user **101** has double clicked on the character and therefore the node label

"CHARACTER#8" **1701** representing the animated character is displayed at the top of the navigation window **804**. Listed below the label **1701** are labels **1702**, **1703**, **1704** and **1705** representing the two simulated objects the character body and the skeleton root, the animation applied to the character, and target scene respectively.

FIG. **18**

The navigation window **804** is shown in FIG. **18** after the user has double clicked on the label "BODY-BB07" **1702** in FIG. **17**. Thus, the label **1702** is displayed at the top of the window **804** and it parent and children are represented by labels displayed below it.

The windows **802** and **803** (not shown in FIG. **18**) remain unchanged in appearance and so continue to display creation tool icons and a view of the animation. While window **805** is updated to display appropriate editing tools

The body of the character **1501** is one of several simulated objects in a group labelled "CHARACTER#8" which defines the character **1501**. Consequently, "CHARACTER#8" is the parent of said body and so label **1701** is displayed below label **1702**.

The simulated objects which provide the appearance of the trousers, shirt and hair of the character **1501** are constrained to the body and so they are children of the body. Thus labels **1801**, **1802** and **1803** representing the trousers, shirt and hair are displayed below label **1702** representing the body.

As shown in the scene tree of FIG. **16**, there are nine levels and thirty-three nodes in the hierarchy for the animation of FIG. **15**. However, it will now be clear that the present invention limits the displayed information so that it is of a quantity that may be easily understood by the user. Furthermore the invention selects the information so that it is most relevant to the user's requirements.

What is claimed is:

1. Animation editing apparatus for editing animation data, said apparatus comprising a data storage, a processing device, a visual display and a manually responsive input device, wherein:

said manually responsive input device is configured to allow a user to indicate a selected point on the visual display;

said visual display is configured to display an image representing a simulated three-dimensional world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

said manually responsive input device is configured to provide an input signal indicating a location within said image corresponding to one of said plurality of related three-dimensional objects based on said selected point;

said processing device is configured to identify said one of said plurality of related simulated three-dimensional objects in response to receiving said location indicated via said input signal, and to retrieve data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional object at said location;

said visual display is configured to display labels identifying said one of said plurality of simulated three-dimensional objects including said related items that are only within said predefined degree among a hierarchy containing each of said plurality of simulated three-dimensional objects.

2. Animation editing apparatus for editing animation data according to claim **1**, wherein said defined degree of relationship is such that said displayed labels identify said selected object and items directly related only to said identified simulated three-dimensional object.

3. Animation editing apparatus for editing animation data according to claim **1**, wherein said displayed related items include a parent item of said identified simulated three-dimensional object.

4. Animation editing apparatus for editing animation data according to claim **1**, wherein said apparatus is configured such that said display identifies said identified simulated three-dimensional object as said identified simulated three-dimensional object.

5. Animation editing apparatus for editing animation data according to claim **1**, wherein

on receiving an input signal from said manually responsive input device indicating selection of one of said displayed labels, said processing device is configured to determine the identity of a selected item corresponding to said indicated displayed label, and said apparatus is configured such that said visual display displays labels identifying the selected item and items directly related to said selected item.

6. Animation editing apparatus for editing animation data according to claim **5**, wherein when said selected item is an attribute, said apparatus is configured to display labels on said visual display identifying said simulated three-dimensional objects to which said attribute is applied.

7. Animation editing apparatus for editing animation data, said apparatus comprising a data storage, a processing device, a visual display and a manually responsive input device, wherein:

said manually responsive input device configured to allow a user to indicate a selected point on the visual display;

said visual display is configured to display an image representing a simulated three-dimensional world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

said manually responsive input device is configured to provide an input signal indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

said processing device is configured to identify said one of said plurality of related simulated three-dimensional objects in response to receiving said location indicated via said input signal, and to retrieve data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional object at said location;

said visual display is configured to display labels identifying said one of said plurality of simulated three-dimensional objects including said related items that are only within said predefined degree among a hierarchy containing each of said plurality of simulated three-dimensional objects; and

said apparatus is such that when one of said displayed labels represents an attribute, and an input is received at said manually responsive input device indicating selection of the label representing said attribute, said apparatus is configured to display labels on said visual display

identifying the selected attribute and each simulated three-dimensional object to which said attribute is applied.

8. Animation editing apparatus for editing animation data, said apparatus comprising a data storage, a processing device, a visual display and a manually responsive input device, wherein:

said manually responsive input device configured to allow a user to indicate a selected point on the visual display;

said visual display is configured to display an image representing a simulated three-dimensional world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

said manually responsive input device is configured to provide an input signal indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

said processing device is configured to identify said one of said plurality of related simulated three-dimensional objects in response to receiving said location indicated via said input signal, and to retrieve data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional objects at said location;

said visual display is configured to display labels identifying said one of said plurality of simulated three-dimensional objects including said related items that are only within said predefined degree among a hierarchy containing each of said plurality of simulated three-dimensional objects; and

said apparatus is configured such that when said selected simulated three-dimensional object is constrained to another simulated three-dimensional object, said displayed related items include said another simulated three-dimensional object.

9. A method of editing animation data in a data processing system, said system comprising a data storage, a processing device, visual display and manually responsive input device, comprising:

receiving a selected point indicated by a user on the visual display;

displaying an image representing a simulated three-dimensional world-space on said visual display, said world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

receiving an input at said manually responsive input device indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

identifying said one of said plurality of related simulated three-dimensional objects in response to receiving said input;

automatically retrieving data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional object at said location; and

displaying labels on said visual display identifying said one of said plurality of simulated three-dimensional objects including said related items that are only within said predefined degree among a hierarchy containing said plurality of simulated three-dimensional objects.

10. A method of editing animation data in a data processing system according to claim **9**, wherein said defined degree of relationship is a direct relationship, such that said displayed labels identify said selected object and items directly related only to said identified simulated three-dimensional object.

11. A method of editing animation data in a data processing system according to claim **9**, wherein said displayed related items include a parent item of said identified simulated three-dimensional object.

12. A method of editing animation data in a data processing system according to claim **9**, wherein said display identifies said identified simulated three-dimensional object as said identified simulated three-dimensional object.

13. A method of editing animation data in a data processing system according to claim **9**, wherein said method comprises:

receiving an input at said manually responsive input device indicating one of said displayed labels;

determining the identity of a selected item corresponding to said indicated displayed label; and

automatically displaying labels on said visual display identifying the selected item and items directly related to said selected item of at least two hierarchal levels.

14. A method of editing animation data in a data processing system according to claim **13**, wherein when said selected item is an attribute, said method comprises displaying labels on said visual display identifying the simulated three-dimensional objects to which said attribute is applied.

15. A method of editing animation data in a data processing system, said system comprising a data storage, a processing device, a visual display and manually responsive input device, comprising:

receiving a selected point indicated by a user on the visual display;

displaying an image representing a simulated three-dimensional world-space on said visual display, said world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

receiving an input at said manually responsive input device indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

identifying said one of said plurality of related simulated three-dimensional objects in response to receiving said input;

retrieving data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional object at said location; and

displaying labels on said visual display identifying said one of said plurality of simulated three-dimensional objects including said related items that are only within said predefined degree among a hierarchy containing each of said plurality of simulated three-dimensional objects, and

wherein said method is such that one of said displayed labels represents an attribute and an input is received at said manually responsive input device indicating selection of the label representing said attribute said method comprises:

displaying labels on said visual display identifying the selected attribute and each simulated three-dimensional object to which said attribute is applied.

16. A computer readable medium having computer readable instructions executable by a computer such that, when executing said instructions, a computer will perform the operation of:

display an image representing a simulated three-dimensional world-space on a visual display means, said world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

receive an input at a manually responsive input device indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

identify said one of said plurality of related simulated three-dimensional objects in response to receiving said input;

automatically retrieve data from said data storage means of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional objects at said location; and

display labels on said visual display means to identify said one of said plurality of related simulated three-dimensional objects including said related items that are only within said predefined degree among a hierarchy containing each of said plurality of related simulated three-dimensional objects.

17. Animation editing apparatus for editing animation data, said apparatus comprising data storage means, processing means, visual display means and a manually responsive input device configured to allow a user to indicate a selected point on the visual display means, wherein:

said manually responsive input device configured to allow a user to indicate a selected point on the visual display means;

said visual display means is configured to display an image representing a simulated three-dimensional world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

said manually responsive input device is configured to provide an input signal indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

said processing means is configured to identify said one of said plurality of related simulated three-dimensional objects in response to receiving said location indicated via said input signal, and to automatically retrieve data from said data storage means of one or more directly related items defining attributes and wherein said directly related items are directly related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said one of the simulated three-dimensional objects at said location, and such that said directly related items include the parent item of said selected object; and

said visual display means is configured to display labels identifying said one of the simulated three-dimensional objects including said directly related items that are only within the predefined degree among a hierarchy containing each of said plurality of simulated three-dimensional objects.

18. Animation editing apparatus for editing animation data according to claim **17**, wherein

on receiving an input signal from said manually responsive input device indicating one of said displayed labels, said processing means is configured to determine the identity of a selected item corresponding to said indicated displayed label, and said apparatus is configured such that said visual display means displays labels identifying the selected item and items directly related to said selected item.

19. Animation editing apparatus for editing animation data according to claim **18**, wherein when said selected item is an attribute, said apparatus is configured to display labels on said visual display means identifying the simulated three-dimensional objects to which said attribute is applied.

20. Animation editing apparatus for editing animation data, said apparatus comprising a personal computer having data storage, a processor, a visual display unit and a manually responsive input device, wherein:

said manually responsive input device is configured to allow a user to indicate a selected point on the visual display;

said visual display unit is configured to display an image representing a simulated three-dimensional world-space including a simulated three-dimensional object comprised of a plurality of related three-dimensional simulated objects;

said manually responsive input device is configured to provide an input signal indicating a location within said image corresponding to one of said plurality of related three-dimensional simulated objects based on said selected point;

said processor is configured to identify said one of said plurality of related three-dimensional simulated objects in response to receiving said location indicated via said input signal, and to automatically retrieve data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified three-dimensional simulated objects at said location; and

said visual display unit is configured to display labels identifying said one of said plurality of simulated three-dimensional objects including said related items that are only within the predefined degree among a hierarchy containing each of said plurality of simulated objects, wherein

on receiving a further input signal from said manually responsive input device indicating one of said displayed labels, said processor is configured to determine the identity of a selected item corresponding to said indicated displayed label, and said apparatus is configured such that said visual display unit displays labels identifying the selected item and items directly related to said selected item.

21. Animation editing apparatus for editing animation data according to claim **20**, wherein when said selected item is an attribute, said apparatus is configured to display labels on said visual display unit identifying the simulated three-dimensional objects to which said attribute is applied.

22. A method of editing animation data in a data processing system, said system comprising a data storage, a processing device, a visual display and a manually responsive input device, comprising:

receiving a selected point indicated by a user on the visual display;

displaying an image representing a simulated three-dimensional world-space on said visual display, said world-space including a simulated three-dimensional object comprised of a plurality of related simulated three-dimensional objects;

receiving an input at said manually responsive input device indicating a location within said image corresponding to one of said plurality of related simulated three-dimensional objects based on said selected point;

identifying said one of said plurality of related simulated three-dimensional objects in response to receiving said input;

automatically retrieving data from said data storage of one or more related items defining attributes related to said identified simulated three-dimensional object, wherein said attributes have hierarchy levels of a single predefined degree among degrees of relationships corresponding only to said identified simulated three-dimensional object at said location; and

providing a user interface displaying the identified simulated three-dimensional object and only said at least one or more stored related item that has editable features in a display view.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,692,657 B2
APPLICATION NO. : 10/313170
DATED : April 6, 2010
INVENTOR(S) : Andre Gauthier

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 4, Line 23, Change "SHERE1" to --SPHERE1--
Column 4, Line 23, Change "SHERE2" to --SPHERE2--
Column 6, Line 34, Change "Thus" to --Thus,--
Column 6, Line 45, Change "tools" to --tools.--
Column 6, Line 67, Change "event" to --events,--
Column 9, Line 17, Change "tools" to --tools.--

Signed and Sealed this

Seventeenth Day of August, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office